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Kerns et al.

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(54) **SOLAR POWER SYSTEM**

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(73) Assignee: **SOL-ELECTRICA, LLC**, Worthington, IN (US)

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F03G 6/00	(2006.01)
F03G 6/06	(2006.01)
F01D 1/36	(2006.01)

(52) **U.S. Cl.**
CPC ***F03G 6/065*** (2013.01); ***F01D 1/36*** (2013.01); *Y02E 10/46* (2013.01)

(58) **Field of Classification Search**
CPC F01D 1/36; F03G 6/065; Y02E 10/46
USPC 60/641.8–641.15; 126/663, 643
See application file for complete search history.

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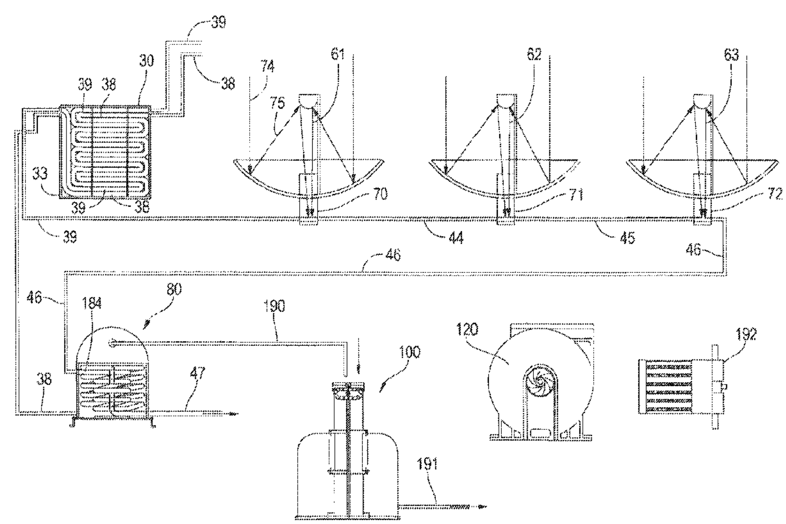
(57) **ABSTRACT**

A solar power system includes a preheating device for heating first heat transfer fluid and second heat transfer fluid in separate tubes. The preheated second heat transfer fluid is routed to a boiler. The preheated first heat transfer fluid is routed through a plurality of heat sinks each associated with a solar radiation collector concentrator. Vacuum chambers receive the solar radiation from specially designed dishes with hyperparabolic feed antennas and direct energy to the heat sinks transferring the heat energy to first heat transfer fluid routed through the heat sink. The lower half of each chamber extends below each dish and has an interior reflective coating on the interior of the chamber side wall. The heated first heat transfer fluid is routed through a coil within the boiler to heat the second heat transfer fluid within the boiler. The boiler outlet steam is routed through a turbine, in turn, connected to a gearing system and an alternator. An insulative cover for the turbine adds energy efficiency to the system and helps reduce noise.

17 Claims, 13 Drawing Sheets



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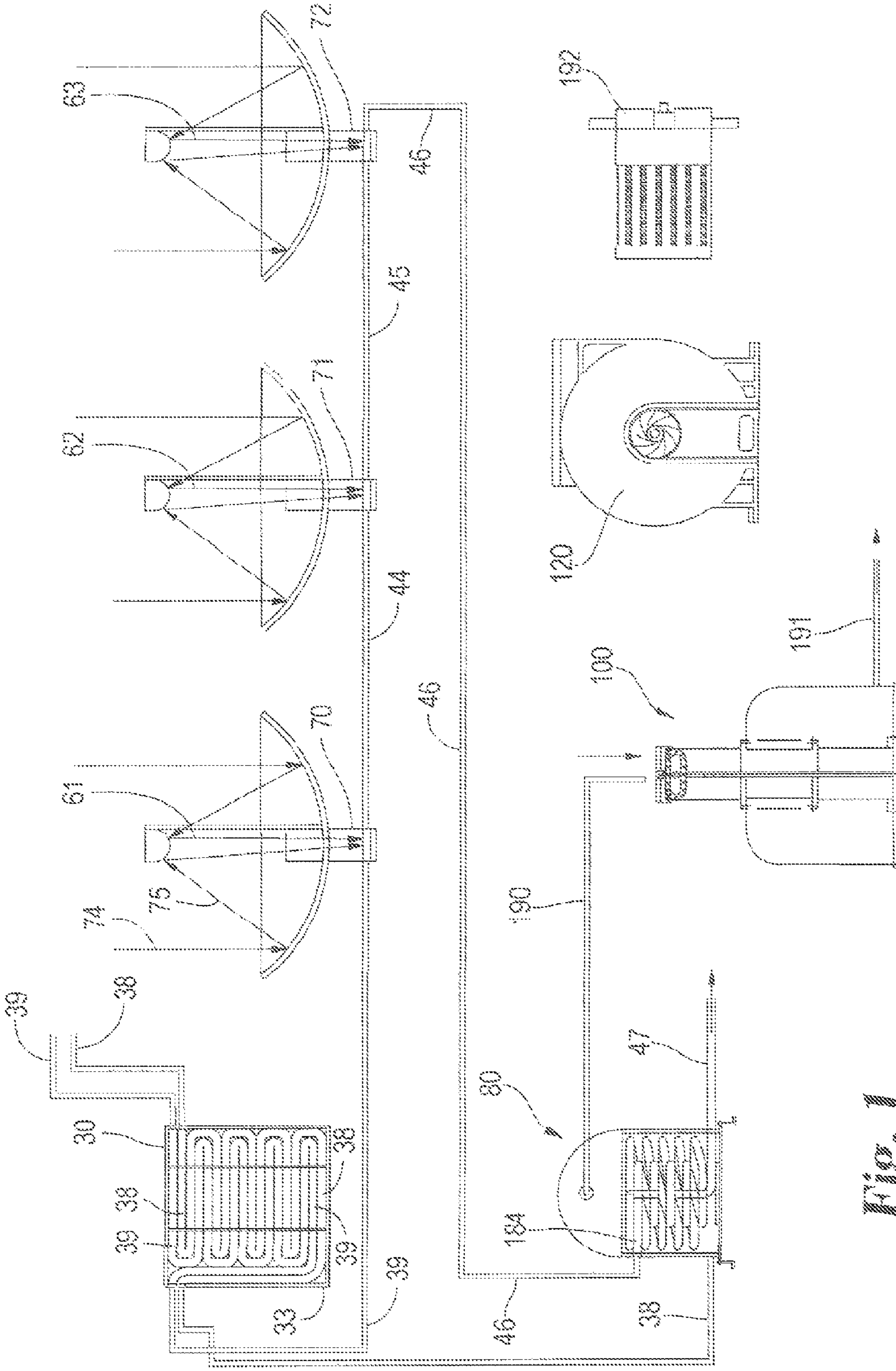
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72
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44
46
100
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33
80
47
184
46
38

Fig. 1

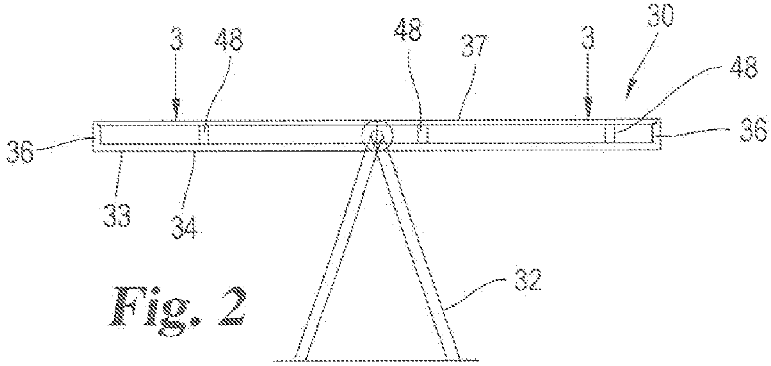


Fig. 2

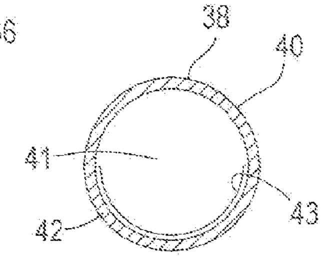


Fig. 4

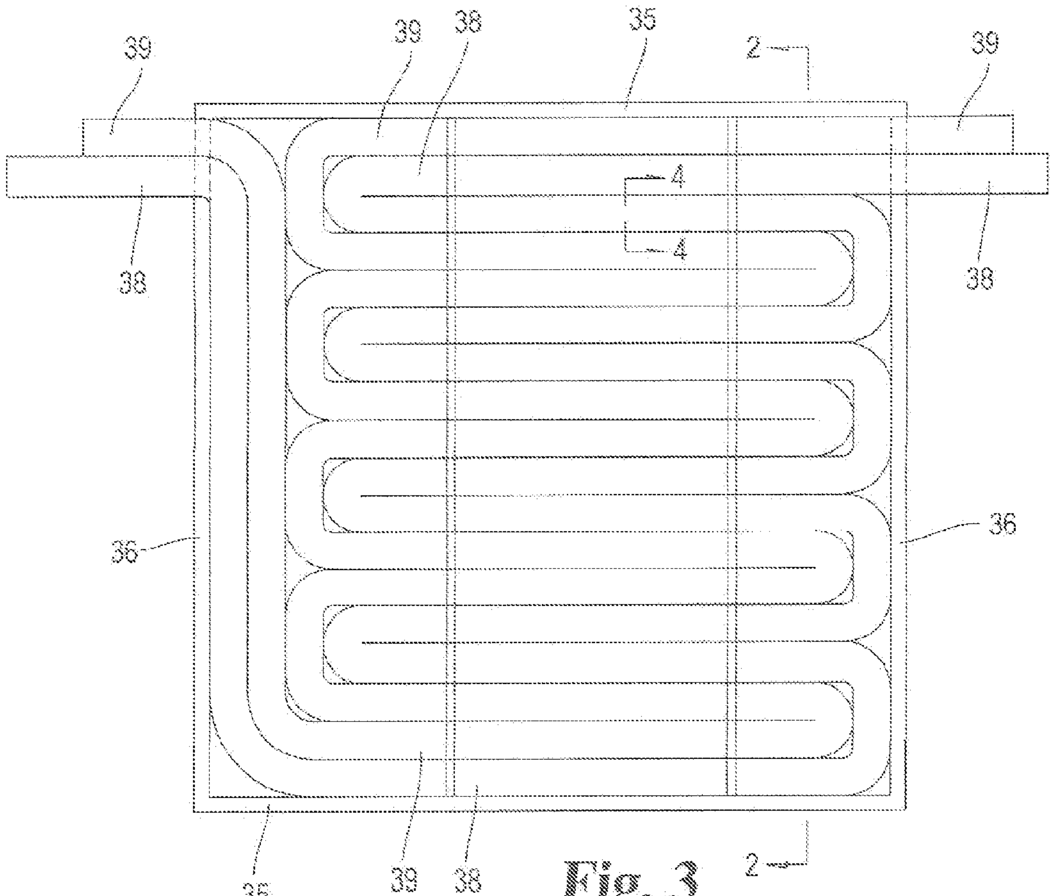


Fig. 3

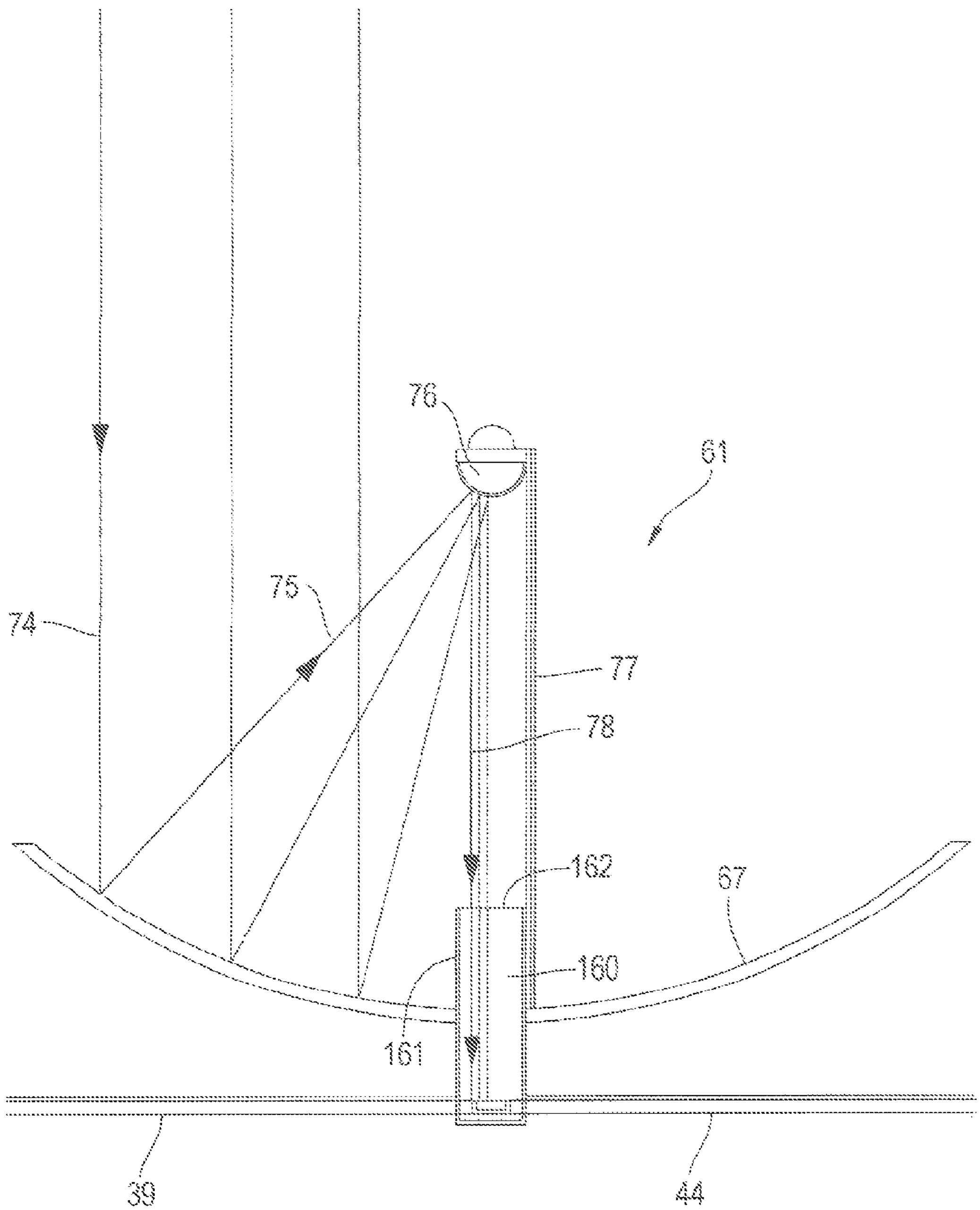


Fig. 5

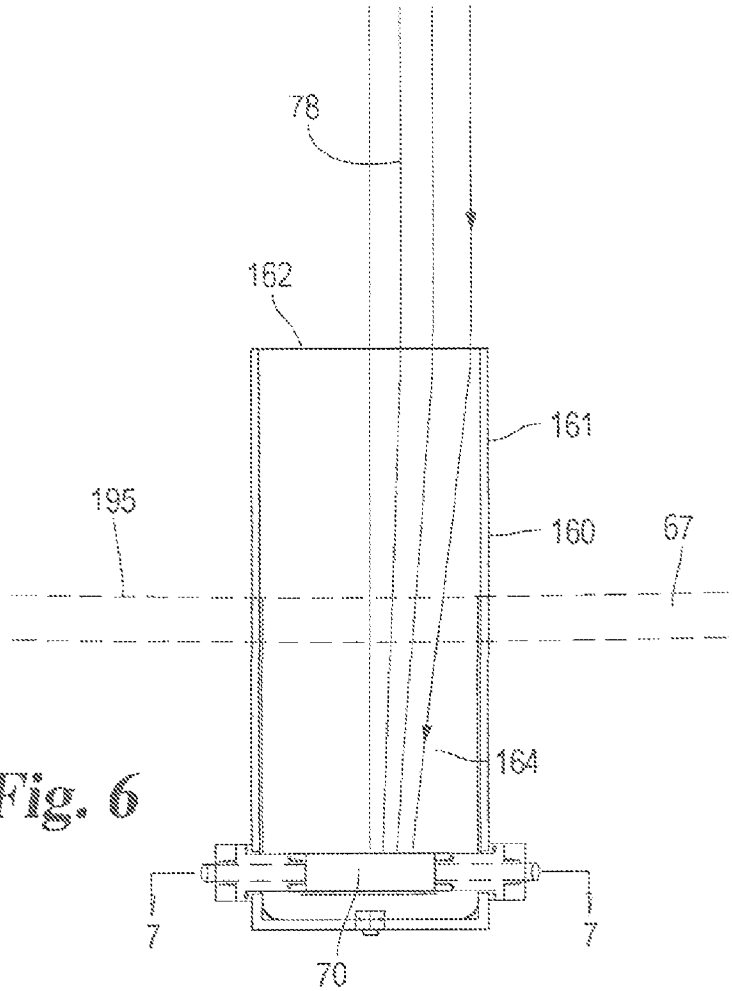


Fig. 6

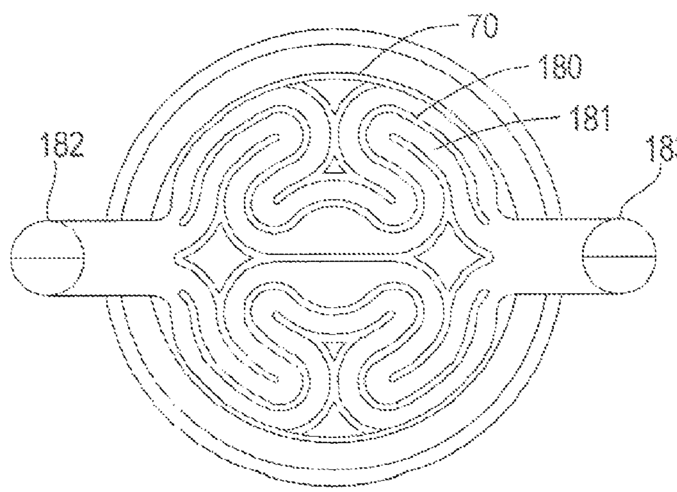


Fig. 7

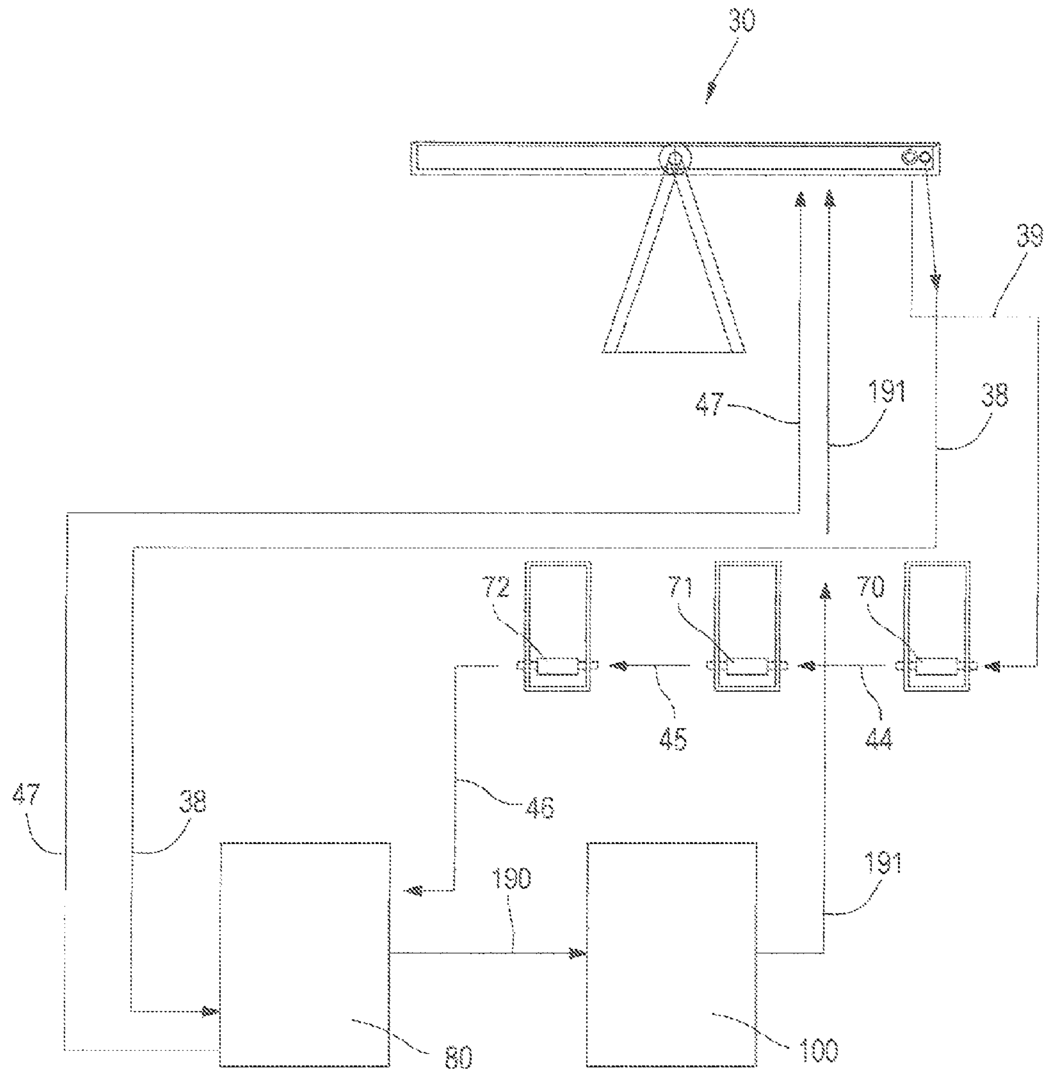
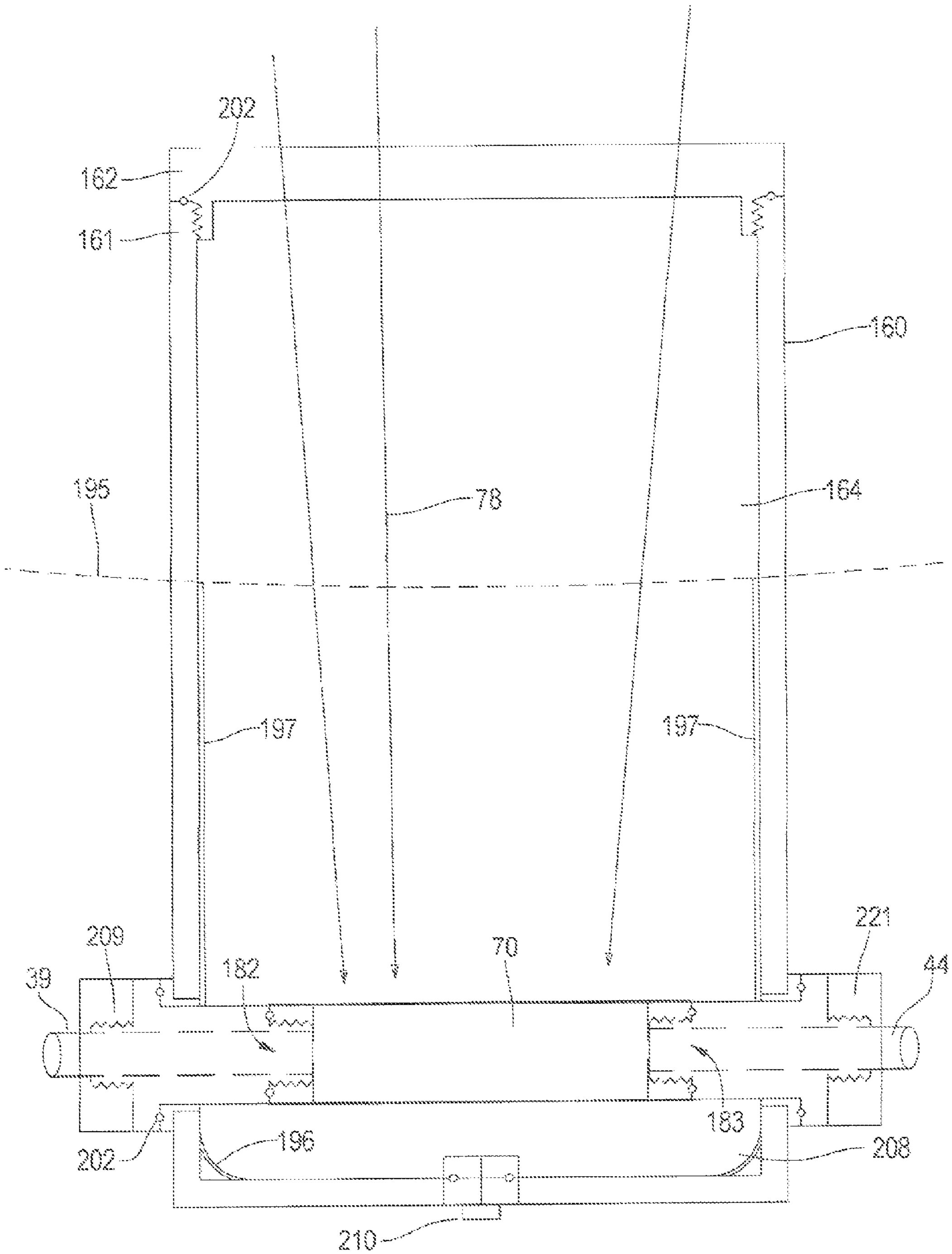


Fig. 8


202
162
161
160
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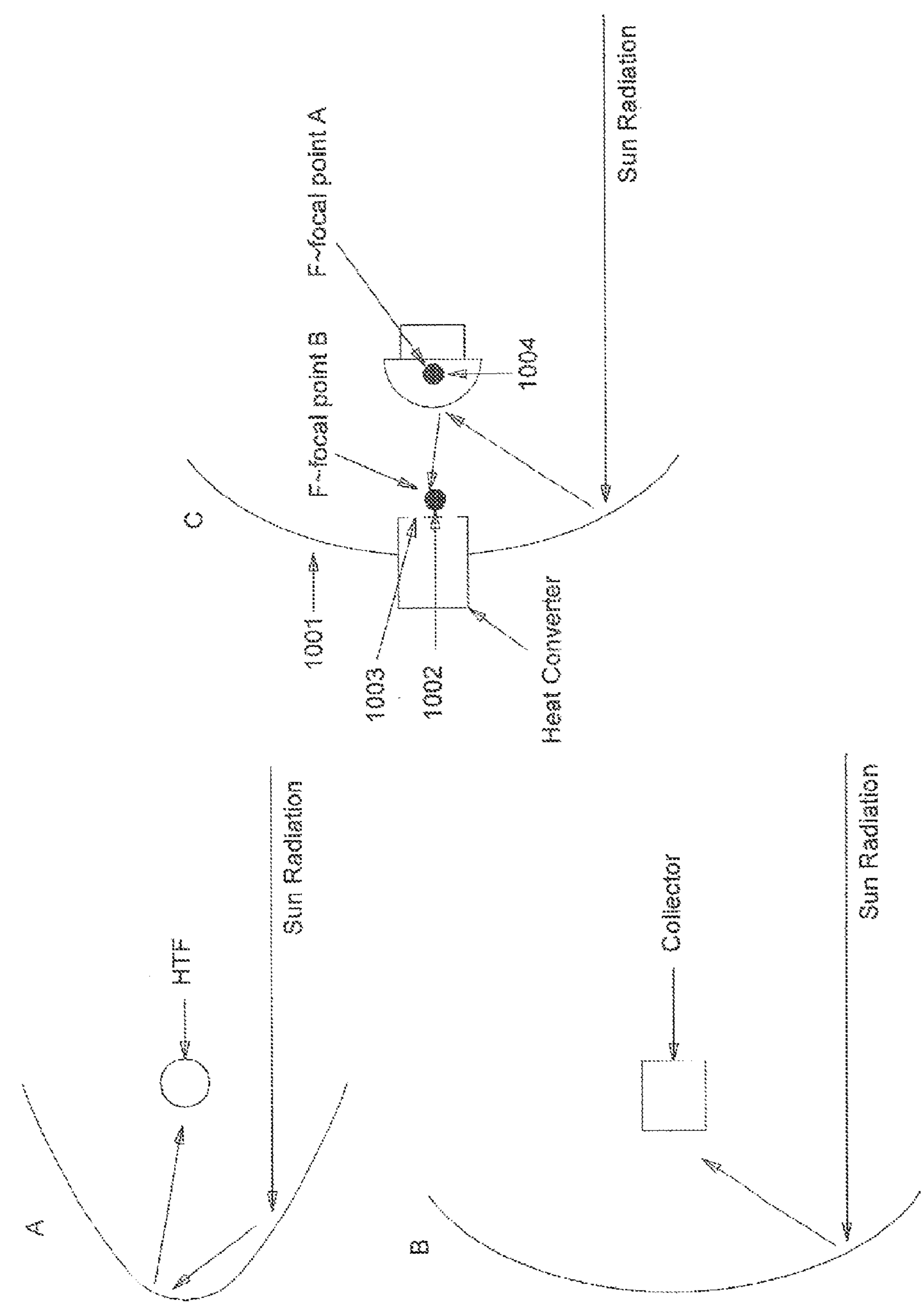
197
197
209
39
182
70
221
44
202
196
183
208
210

Fig. 9

Figure 10


A
HTF
Sun Radiation
B
Collector
Sun Radiation
C
1001
1003
1002
Heat Converter
F~focal point B
F~focal point A
1004
Sun Radiation

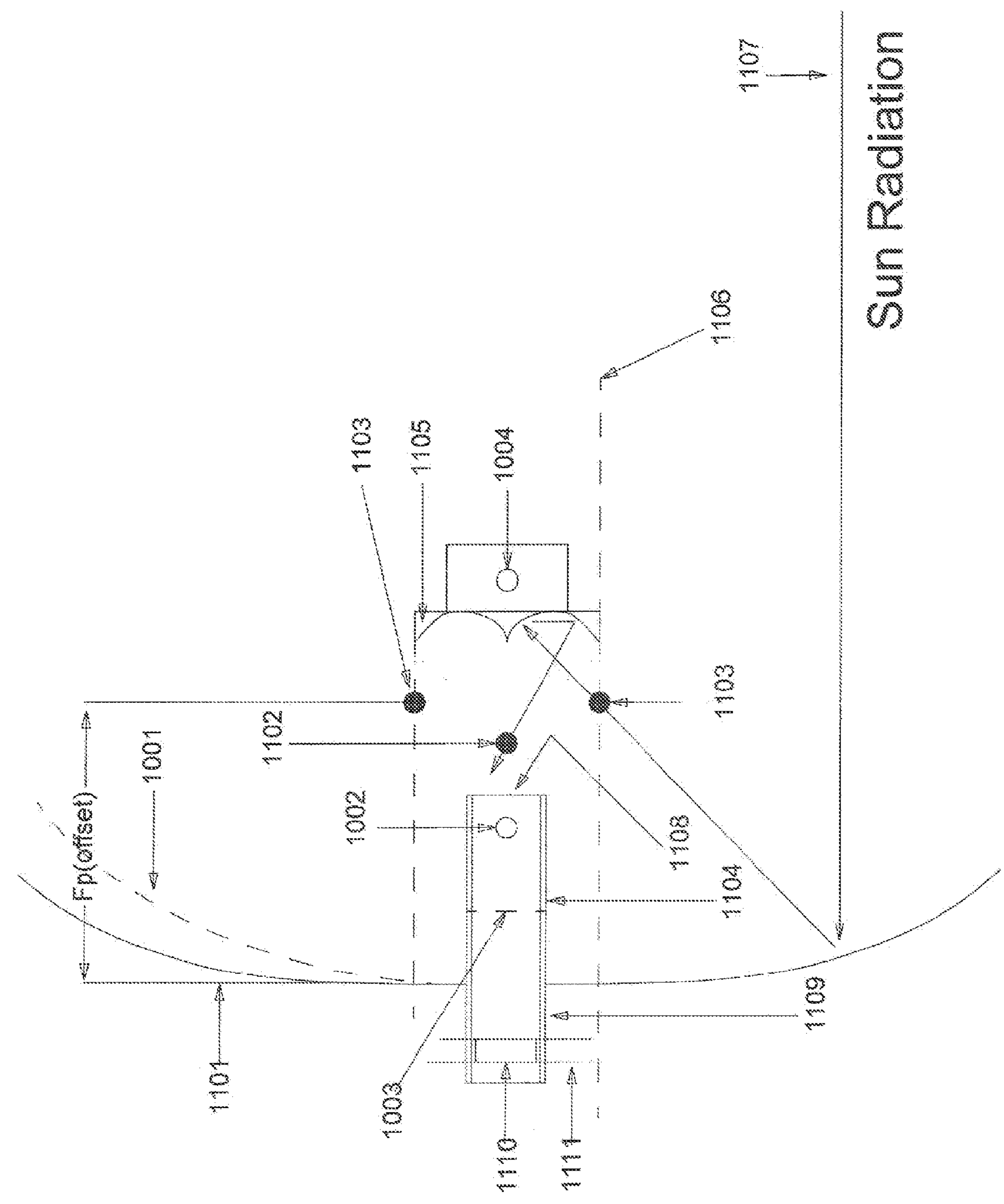

Sun Radiation
1107
1106
1103
1105
1004
1103
1102
1001
Fp(offset)
1002
1108
1104
1109
1101
1003
1110
1111

figure 11

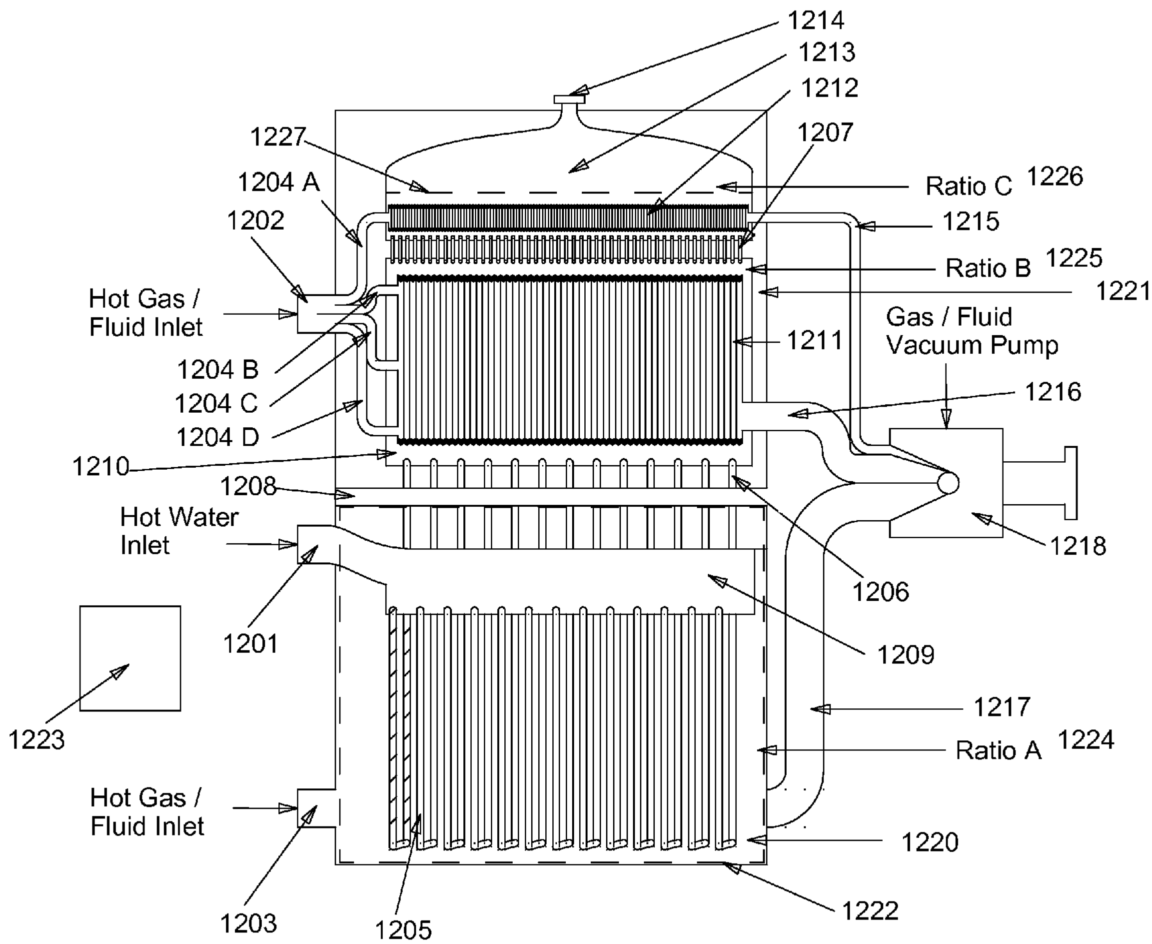

1214
1213
1212
1227
1207
1204 A
Ratio C 1226
1202
1215
Ratio B 1225
1221
Hot Gas / Fluid Inlet
Gas / Fluid Vacuum Pump
1211
1204 B
1204 C
1216
1204 D
1210
1208
Hot Water Inlet
1218
1206
1201
1209
1223
1217
Ratio A 1224
Hot Gas / Fluid Inlet
1220
1222
1203
1205

Fig. 12

Figure 13

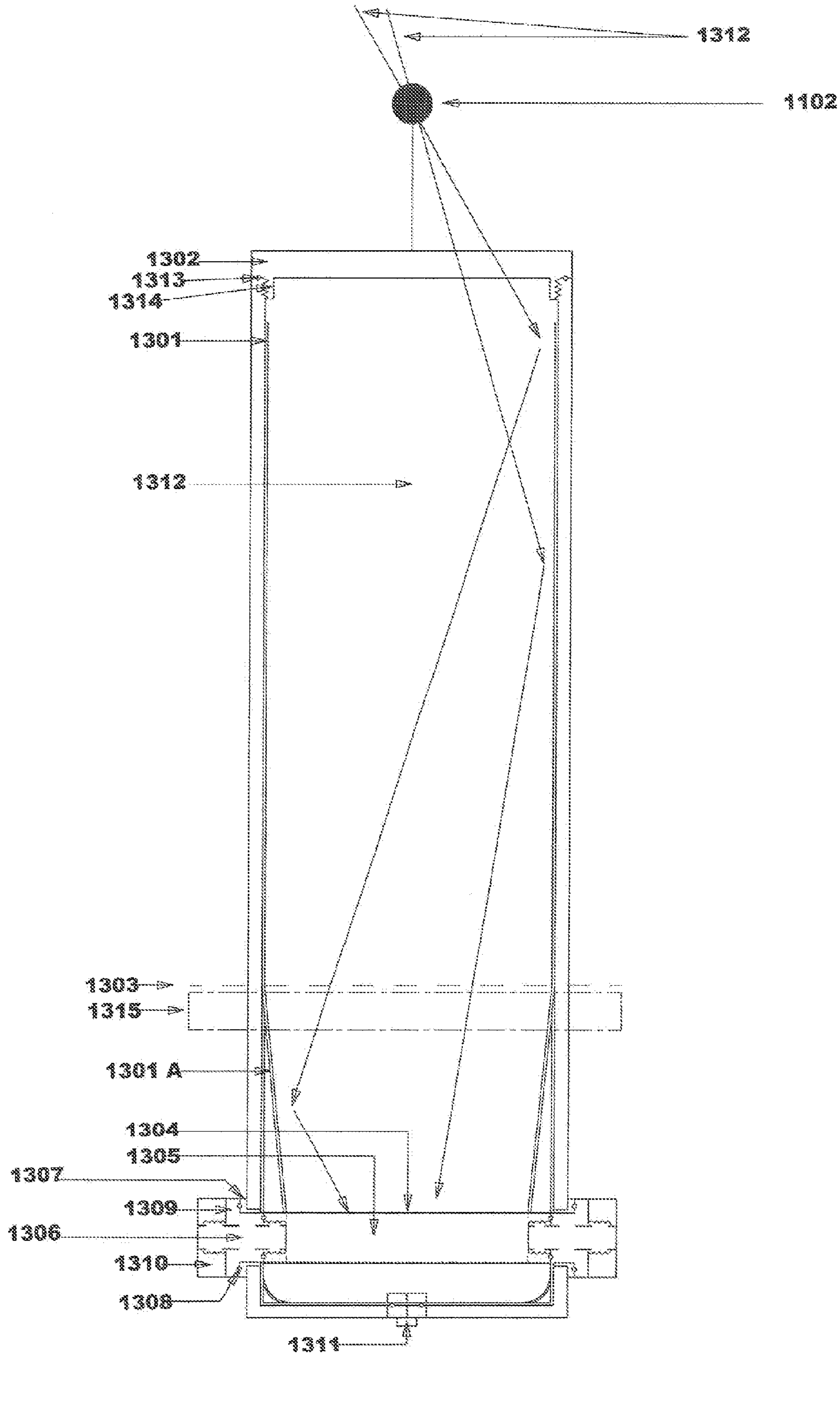

1312
1102
1302
1313
1314
1301
1312
1303
1315
1301 A
1304
1305
1307
1309
1306
1310
1308
1311

figure 14

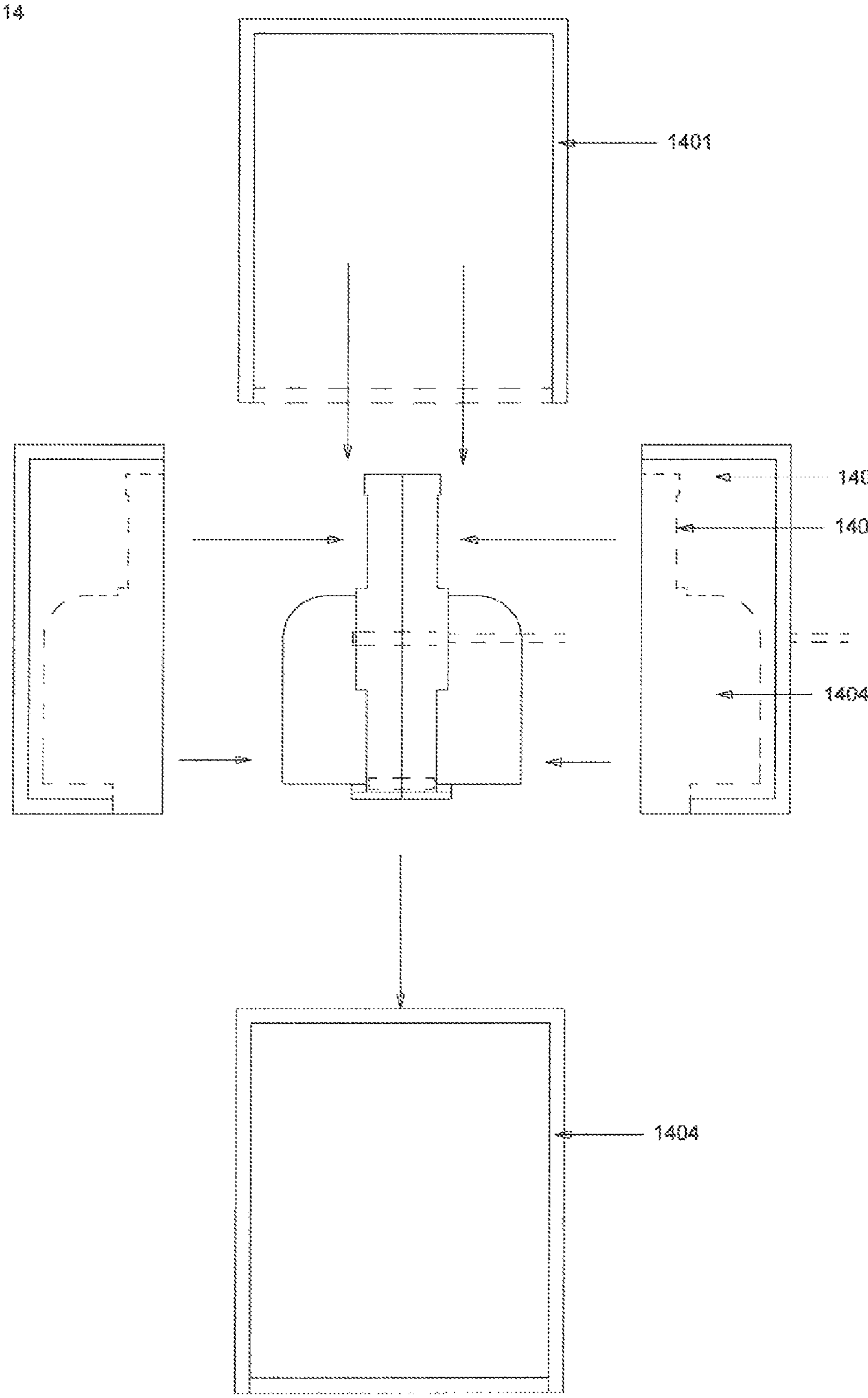


Figure 15

Single Modular Turbine Unit

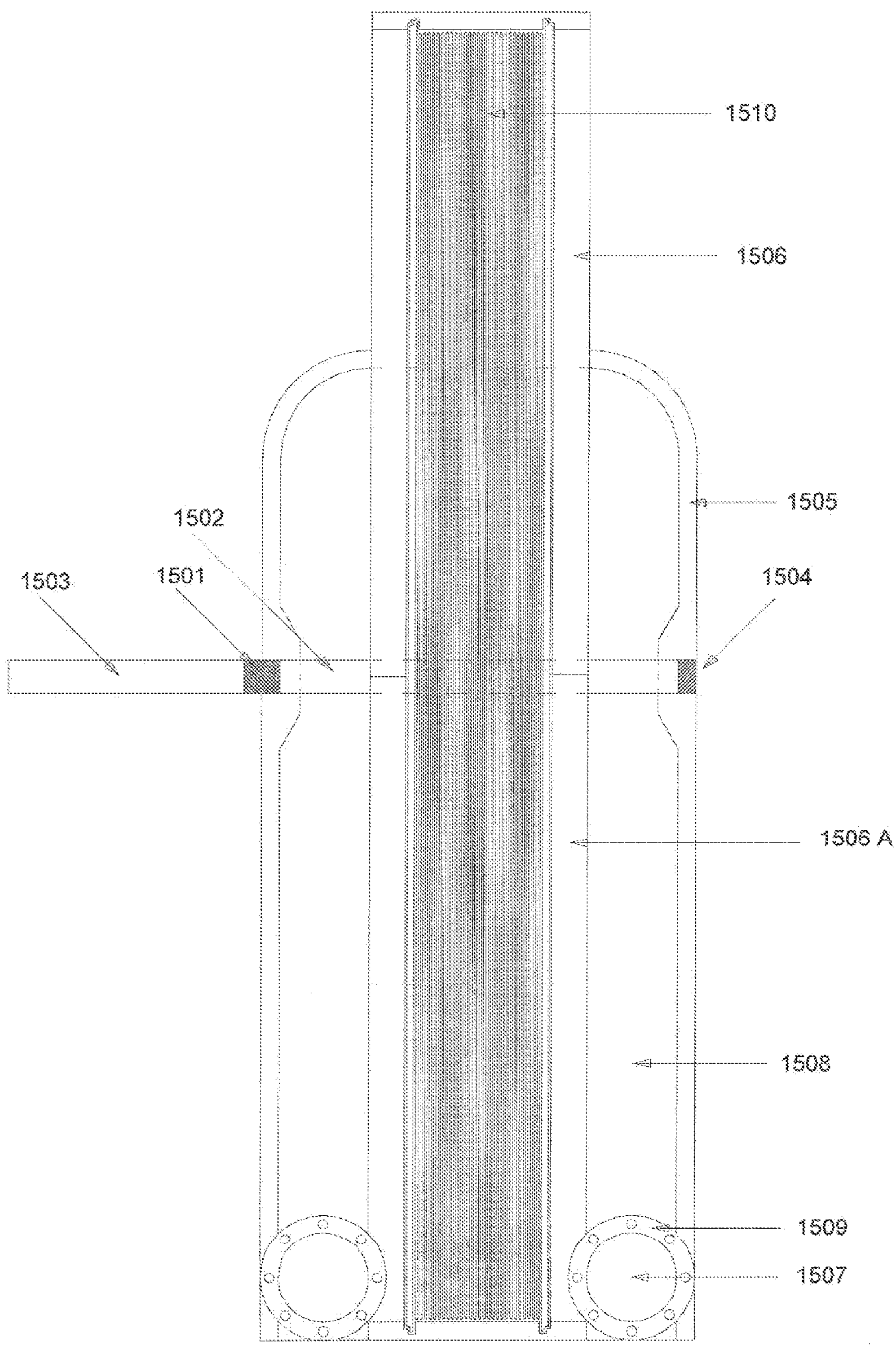
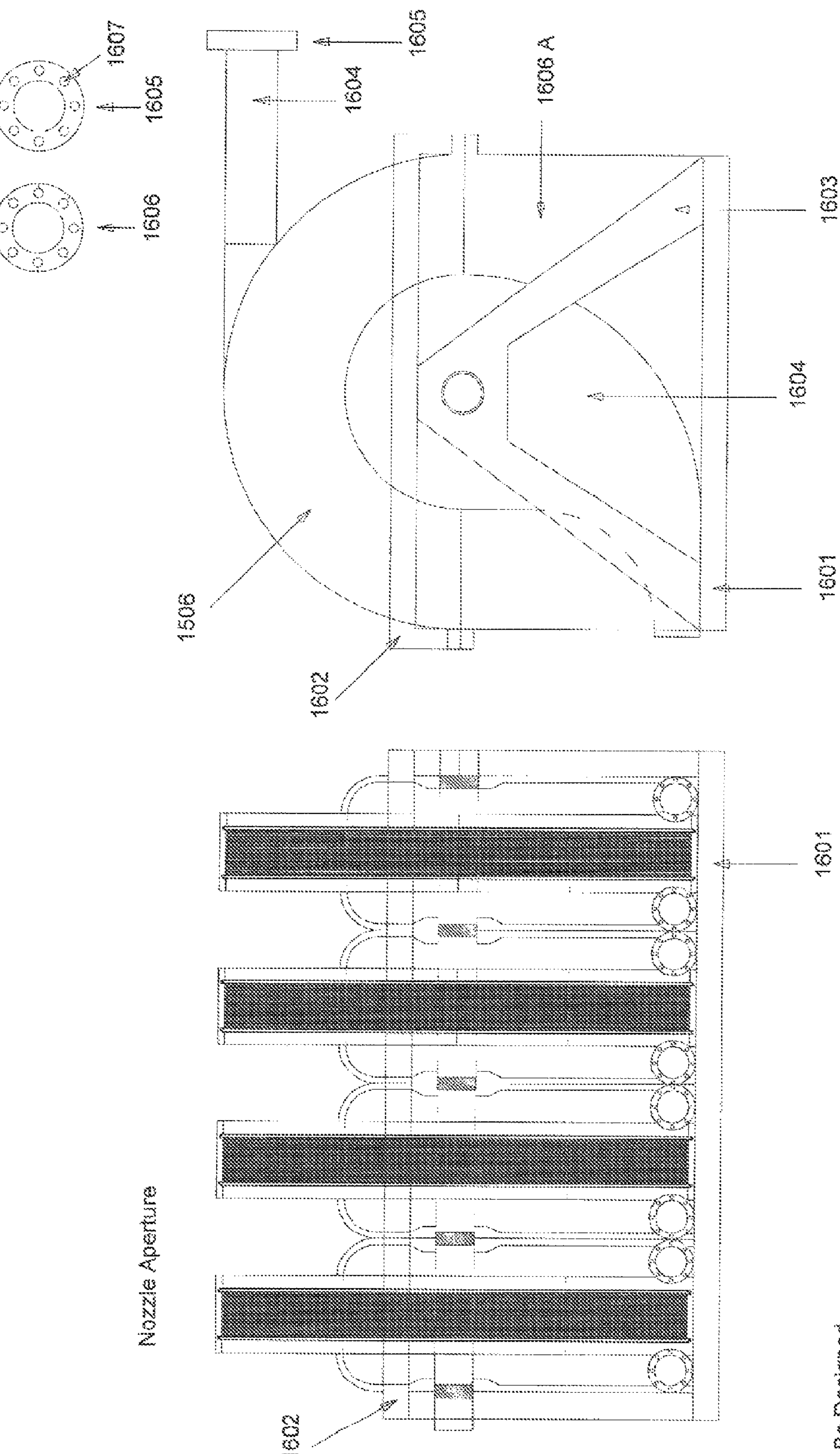


Figure 16

Modular cutaway and side view (4 units)



To Be Designed

Shaft Seals
External Exhaust Port Size
Nozzle Design & Number

SOLAR POWER SYSTEM

REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of, and claims priority to, U.S. application Ser. No. 13/871,365, filed Apr. 26, 2013, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the field of systems for converting solar energy into mechanical or electrical energy.

2. Description of Related Art

Increased emphasis has been placed on systems for converting solar energy into mechanical and/or electrical energy due to increased energy demand and the scarcity of certain natural resources. A variety of systems have been employed with many including solar collectors connected via a fluid system to a boiler, in turn, connected to various components for producing mechanical and/or electrical energy.

It is known to collect solar energy by a parabolic reflector and then direct the energy through a lens system with the resultant heat energy directed onto a head of a conductor having a bottom end extending into a reservoir of water. Steam is thereby created in the reservoir and used to power a turbine. The resulting mechanical energy from the turbine may be used to generate electrical energy. Such an approach is discussed in U.S. Pat. No. 4,068,474 issued to Dimitroff.

Further, with respect to the parabolic reflector, the most commonly used means for collecting solar radiation for the production of electricity includes the parabolic trough (A) and parabolic dish (B) designs illustrated in FIG. **10**. Both types of collection designs focus the sun's rays into a central focal point thus concentrating the solar radiation into a HTF tube, which transports the heat into a central heat storage unit or a solar absorber. New designs for concentrating solar radiation into the center of the main parabolic dish nave been, proposed. One such design, which is shown at (C) of FIG. **10**, includes a parabolic collector and its counterpart hyperparabolic concentrator with a pure parabolic curve **1001**, a rear offset focal point from the main parabolic collector **1004**, an inward parabolic central local point from the concentrator **1002**, and a raised plane collection point **1003**.

In Patent Application Publication US 2012/0124999 of Gruss et al., there is disclosed a low temperature power plant including a tubular solar collector comprising an outer tube containing a vacuum and an inner tube. A plurality of the solar collectors are used to direct heat energy to a heat transfer fluid for powering a boiler and a turbine coupled to an electric generator.

U.S. Pat. No. 4,000,733 issued to Pauly discloses a solar furnace receiving reflected solar energy from a battery of postionable mirrors with the furnace having reflectors directing concentrated radiant energy towards a Fresnel lens.

U.S. Pat. No. 6,000,211 issued Bellac et al. discloses a combustion turbine power plant wherein air is cooled using solar energy and supplied to the air inlet of the power plant to support combustion. Further, the patent discloses combustion turbine power plants in which steam is produced using the solar energy and ejected into a turbine of the power plant.

U.S. Pat. No. 3,985,118 issued to Bard discloses a solar furnace wherein a plurality of Fresnel lenses focus light rays upon heat conductors. Fluid passing through an associated vessel, it is used to provide steam for a steam turbine associated with an electrical generator.

U.S. Patent Application Publication 201110290235 of New Delman discloses an evacuated solar conductor having a cavity positioned between a top casing that is partially transparent and a bottom portion forming a heat sink. Solar energy is transmitted through the transparent top casing to the heat sink portion.

In the U.S. Pat. No. 3,993,041 issued to Diggs, there is disclosed a solar energized steam generator system wherein a lens is used for collecting and concentrating solar energy along with reflector funnel for enhancing and concentrating the solar energy. The funnel is connected by means of a conduit to an insulated vault. An air duct operatively connected to the vault is in a heat exchange relationship with a steam generator.

U.S. Pat. No. 8,341,961 discloses a solar desalination system wherein a hydroturbine is connected to a steam turbine condenser for the purpose of generating desalinated water.

U.S. Pat. No. 1,061,206 discloses an example of a bladeless turbine and is herewith incorporated by reference on the structure of one such turbine.

SUMMARY OF THE INVENTION

One embodiment of the present invention is a solar power system for converting solar radiation into mechanical and electrical energy. The solar power system includes a preheater with a first tube to hold a first heat transfer fluid and a second tube to hold a second heat transfer fluid. The first tube and the second tube have side walls allowing solar radiation to flow inwardly through the side walls and preheat the first heat transfer fluid and second heat transfer fluid hut limit flow of radiation outwardly there from. A combination collector and concentrator has a vacuum chamber containing an internal heat sink with a circuitous passage. The collector and concentrator collects solar radiation and concentrates energy via the vacuum chamber into the heat sink. A first heat transfer fluid conduit extends to and between the first tube and the heat sink routing the first heat transfer fluid through the circuitous passage of the heat sink; to allow heat in the heat sink to be absorbed by the first heat transfer fluid in the first conduit. The heated first heat transfer fluid is then directed to a boiler heating the second heat transfer fluid within boiler. A turbine is connected to a steam output of the boiler and is operable to convert energy into a mechanical output. An alternator is operable to convert the mechanical output of the turbine into electrical energy.

It is an object of the present invention to collect, concentrate and convert solar radiation into heat, which is then transferred to a fluid for use in powering a heat engine.

It is an object of the present invention to provide a new and improved solar power system for converting solar radiation into mechanical and/or electrical energy.

Related objects and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic flow diagram illustrating the major components of the solar power system.

FIG. **2** is a side view of the solar panel shown in FIG. **1** pivotally mounted atop a base.

FIG. **3** is an enlarged top view of the solar panel shown in FIG. **1** and FIG. **2**.

FIG. **4** is an enlarged cross-sectional view taken along a line and viewed in the direction of arrows **4-4** of FIG. **3** illustrating the construction of a fluid conveying tube.

FIG. **5** is an enlarged view of the collector/concentrator illustrated in FIG. **1**.

FIG. **6** is an enlarged cross sectional view of the vacuum chamber with a heat sink shown mounted to the dish of FIG. **5**.

FIG. **7** is an enlarged cross-sectional view taken along a line and viewed in the direction of arrows **7-7** of FIG. **6** illustrating the heat sink.

FIG. **8** is a flow diagram illustrating the flow of first heat transfer fluid and second heat transfer fluid between the major components of the solar power system of FIG. **1**.

FIG. **9** is an enlarged cross-sectional view of the vacuum chamber with heat sink of FIG. **5**.

FIG. **10** shows prior art designs for parabolic trough, parabolic dish apparatus, and hyper parabolic concentrator.

FIG. **11** is a diagrammatic cross-sectional view of an outward receded parabolic collection dish of the invention showing its characteristic ringed focal area and the forward facing hyperparabolic concentrator.

FIG. **12** is a vertical cutaway view of a water-tube fire-tube triple chamber rapid flash steam boiler.

FIG. **13** is a vertical cutaway view of the sealed vacuum collection chamber and internal heat sink of the invention.

FIG. **14** is an enlarged view of a heat capture and noise reduction enclosure for the system turbine.

FIG. **15** is a vertical cutaway view of a single modular boundary layer turbine.

FIG. **16** shows a vertical cutaway view and a side view of multiple modular boundary layer turbines.

DETAILED DESCRIPTION OF INVENTION

For the purposes of promoting an understanding of the principles of the invention, specific embodiments have been described. It should nevertheless be understood that the description is intended to be illustrative and not restrictive in character, and that no limitation of the scope of the invention is intended. Any alterations and further modifications in the described components, elements, processes, or devices, and any further applications of the principles of the invention as described herein, are contemplated as would normally occur to one shaded in the art to which the invention relates.

The solar power system begins with the preheating of two heat transfer fluids. At the beginning of a day's cycle the sun's radiation penetrates the transmissive front of a dual heat transfer fluid preheating modular tracking panel **30** (FIG. **1**) and travels through the partial vacuum which is enclosed in housing **33** that also contains transmissive glass tubes **38** and **39** (FIG. **3**). The tubes have copper inner lining **43** (FIG. **4**) that act as a heat sink to further capture and radiate the fullest amount of solar energy and prevent the loss of radiation through the back portion **42** (FIG. **4**) of the internal high pressure tubing **38** and **39**. Panel **30** is a dual preheating device that allows the fullest amount of solar radiation to excite and heat fluids circulated through tubes **38** and **39** by remaining nearly perpendicular to the sun's rays during morning hours of each daily cycle. Since both fluids are in a closed loop, the pressure within the tubes builds during the preheating process and thus the need for very high pressure resistant transmissive tubing. For example, 100 atmospheres or more may be obtained during peak performance of the complete system at maximum thermal capacity.

The flow of each fluid remains stagnant until the proper temperature and saturated steam psig is reached in the micro-boiler **80** (FIG. **1**) for the system to begin normal operations. Once at operation temperature, circulation valves are open and pumps begin circulating the fluids through the complete

system. Pumps are used to circulate the second heat transfer fluid in tube **38** and the first heat transfer fluid in tube **39** through the system and back to panel **30**. The heat transfer fluid circulated through tube **39** is in the preferred embodiment is a gas, whereas the fluid circulated through tube **38** is a liquid, such as water. It is to be understood that the present invention includes fluids circulated through tubes **38** and **39**, such as a gas in tube **39** and a liquid in tube **38** so long as the fluid circulated through tube **38** when boiled turns to steam or gas to drive the turbine connected to the boiler. The liquid circulated through tube **38** may therefore be referred to as a boiler turbine fluid and is dissimilar from the heat transfer fluid circulated through tube **39**. The fluid circulated through tube **38** is pumped from panel **30** directly into micro-boiler **80**. The first heat transfer fluid, for example pressurized helium, is pumped through tube **39** from panel **30** and then through heat sinks attached to a plurality of collector concentrators **61-63** (FIG. **1**) gaining heat through each pass through heat sinks. The first heat transfer fluid is then pumped into coils within the boiler **80** to heat the second heat transfer fluid to a predetermined operational psig. In the embodiment shown in FIG. **1**, there are three collector concentrators connected together in series thereby comprising collector concentrator **61**, **62** and **63**. Less than three or more than three collector concentrators are included in the present invention depending upon the amount of heat desired to heat the first heat transfer fluid circulated through the system to the micro-boiler. The power system is thus scalable with respect to the collector concentrator(s) and other of the system's components.

Each collector concentrator during normal operation track the sun's daily path and collect and concentrate the full spectrum radiation into a vacuum chamber and heat sink in order to transfer the heat into the first heat transfer fluid that is traveling through the thermally insulated device.

Once both the second and first heat transfer fluids circulated through the system reach the desired temperature and the desired pressure inside the micro-boiler is obtained, a saturated steam valve is open and the steam or fluid exits the micro-boiler and routed to the blades or discs of turbine **100**. The rotatable output of turbine **100** is connected to gear system, such as an epicyclic gear mechanism **120**(FIG. **1**), in turn, connected to alternator **192** to begin producing electric current. The turbine remains operational from a predetermined RPM range output through the entire daily sunlight cycle.

Referring now more particularly to FIGS. **2-4**, tracking panel **30** includes a rectangular shape solar housing **33** pivotally mounted atop base **32**. Housing **33** includes a rigid box shape construction with a bottom wall **34** joined to a pair of end walls **35** and a pair of side walls **36**. The top wall **37** is mounted to the end walls and side walls thereby forming an enclosure in which tubes **38** and **39** extend back and forth between the side walls **36** in a side by side relationship along the length of housing **33** between the opposite end walls **35**. In the preferred embodiment, top wall **37** is produced from a glass to allow the sun rays to penetrate whereas walls **34** and **36** are produced from metal. The resultant enclosure formed by walls **34-37** is a vacuum or at least partial vacuum enclosure through which tubes **38** and **39** extend. In order to provide structural rigidity for glass wall **37** a plurality of strengthening spacers **48** are provided extending from bottom wall **34** toward and against top wall **37**. Spacers **48** (FIG. **2**) are rigid and may take many different shapes and forms. For example, in the preferred embodiment spacers **48** are pins. In order to provide adequate space for spacers **48** to extend between walls **34** and **37**, tubes **38** and **39** may be slightly spaced apart to accommodate the pins.

The main purpose of the solar panel **30** is to preheat the fluids within each tube **39** and **38** prior to entering respectively the heat sinks of the collector/concentrators **61-63** (FIG. **1**) and me micro-boiler **80**. Both the first heat transfer fluid circulated in tube **39** and the liquid, such, as water, circulated through tube **38** are in a closed, loop system and enter one end of panel **30** adjacent one of the side walls and then exit through the same tube on the opposite side of panel **30**. Tubes **38** and **39** are placed beneath and adjacent top wall **37** which is produced from a highly sunlight transmissive material, such as glass. The remaining walls of housing **33** are opaque to the passage of solar radiation. Top wall **37** remains perpendicular to the sun's radiation by a two axis tracking device. Axis solar tracking devices are commercially available. For example, a slew drive solar tracker is available from SAT Control, Pozenik 10, 4207 CERKL JE, SLOVENIA.

Tube **38** (FIG. **4**) will now be described it being understood that an identical description applies to tube **39**. Tube **38** has a top portion **40** and a bottom **42** formed in one integral piece forming an interior passage **41** for the second heat transfer fluid to flow there through. Top portion **40** has side walls allowing the solar radiation to pass therethrough and preheat the second, heat transfer fluid in the tube. A copper sleeve heat sink **43** is positioned inside passage **41** adjacent the interior surface of bottom portion **42** preventing the sun radiation from passing directly through the internal high pressure tube and hitting the bottom wall **34** of housing **33** to be lost or scattered or unabsorbed radiation. The copper sleeve also acts as an internal heat sink and continues to heat the second heat transfer fluid circulated through tube **38** during normal daylight operations.

Tube **39** is identically constructed as described for tube **38** with the exception that tube **38** is designed to be functional at 150 psig which is the hot water pressure achieved during peak operational periods whereas the borosilicate glass tube **39** is designed to be functional at 1500 psig if the fluid circulated through tube **39** is helium with 1000 lambda thermal conductivity at 100 atmospheres.

Each tube **38** and **39** enter one of the side walls **36** of housing **33** and then extends across the width of the housing between the side walls in a back and forth or serpentine fashion from one end wall **35** to the opposite end wall **35** until eventually both tubes **38** and **39** exit the opposite side wall **36**.

Housing **36** is sealed and is partially evacuated containing less air than the air surrounding the panel. Tubes **38** and **39** are sealed thereby separating the first and second heat transfer fluids from the internal air, if any, within housing **33**. Each high pressure transmissive tube **38** and **39** inside housing **33** is composed of straight portions and requires a connector to achieve 90 and 180 angle turns within the enclosure before exiting the other side. Both the side entrance of each tube into the housing and the side exit of each tube are aligned so that modularity can be achieved if additional panels are needed for scaled systems. Internal separators **48** within the housing hold the high pressure tubes away from all internal surfaces of the interior of the panel that also help to reduce the tendency of the transmissive glass sheet **37** from warping towards the interior due to the partial vacuum.

Collector concentrator **61** will now be described it being understood that an identical description applies to collector concentrator **62** and **63**. A solar thermal vacuum chamber and heat sink are mounted to and beneath a dish **67**. Thus, heat sink **70**, **71** and **72** are mounted, respectively, to the dishes of collector concentrators **61**, **62** and **63**. Heat sink **70** will now be described it being understood that an identical description applies to heat sinks **71** and **72** (FIG. **1**).

The main purpose of the solar collector and concentrators **61-63** including the associated solar thermal vacuum chambers and heat sinks is to convert the sun's radiation into usable heat energy. The design of the collector and concentrator **61** is such that, nearly 90%+of the sun's radiation is focused into the vacuum chamber **160** (FIG. **5**). The design of the solar thermal vacuum is such that nearly all of the captured solar radiation is converted into heat: energy without radiant or reflective loss. All of the converted solar radiation is contained in the internal heat sink **70** (FIG. **6**). In the beginning of each sunlight day, the vacuum chamber **160** turns toward the rising sun so that the main axis of the parabolic dish **67** is positioned to receive the sun's rays. The vacuum chamber **160** is positioned parallel to the sun's rays **74** by the use of a conventional solar tracking system which connects to the underside of the main parabolic dish through three tracks and slew drive positioners.

The sun's rays hit the parabolic dish **67** and reflect off the highly reflective surface of the top side or sun side of the dish. In one embodiment, the reflected light rays **75** are then directed towards a raised hyper parabolic concentrator **76** (Cassagrain design) or a conflex or a convex reflective concentrator (Gregorian design). The concentrated rays **78** are focused into the transmissive top **162** of chamber **160**. The sun's rays **74** are collected by dish **67** (FIG. **5**) resulting in reflective rays **75** directed upwardly to an ellipsoid concentrator **76** which, in turn, directs the rays **78** downwardly to vacuum chamber **160**.

In another embodiment, the collector concentrator(s) dish design includes an outward receded parabolic main collection dish with a ringed focal point and a forward facing concentrator, as shown in FIG. **11**. In that embodiment, the main parabolic dish is not a pure parabola. The outer surface **1101** of the dish is receded by incremental degrees from the pure parabolic surface **1001**. This change is contrary to previous designs that have a single central focal point **1004** to a ringed inwardly positioned focal area **1103** increasing the overall gain of the antennae design. The hyperparabolic concentrator's focal point **1002** is located backwards closer to the new forward facing design **1102**. This design reduces the spillover from the main collector dish's focused solar radiation to the concentrator **1105**. As described in detail below, the vacuum chamber heat sink and HTF gas/fluid flow apparatus (FIG. **13**) is elongated to match this unique backward positioned focal point design of the collector concentrator.

Strut **77** is connected to concentrator **76** and dish **67** and supports the concentrator. It has been determined that the support strut prevents harmonic vibrations from occurring in any given wind environment if irregular holes are drilled through the entire strut along the length thereof.

Referring to FIGS. **5**, **6**, and **9**, the vacuum chamber **160** includes upwardly extending rigid side walls **161**. By the term side walls **161** is meant either a single wall forming the interior chamber or a plurality of walls **161** forming the interior chamber. Side walls **161** and heat sink **70** form an enclosure **164** in which a vacuum is provided to prevent any heat loss. Side walls **161** are produced from a reflective material, such as high quality borosilicate glass so that rays **78** converge towards the heat sink. Side walls **161** surround heat sink **70** and are spaced apart there from allowing the vacuum within chamber **164** to prevent heat loss.

Side walls **161** extend through dish **67** and are attached to the center of the main parabolic dish. Those portions of side walls **161** located above the dish are completely transmissive allowing not only direct focus sun rays to enter through the side walls but incident light to enter from the sides. The side walls **161** have inwardly facing reflective surfaces to reflect the incident light onto the surface of the heat sink. This assures that all available sunlight is directed and converted into heat energy.

Vacuum chamber **160** has a circular screw-on cap **162** produced from high quality borosilicate glass which is threaded onto side walls **161** with an Indium o-ring **202** positioned therebetween to insure the integrity of the vacuum. Side walls **161** form the chamber with a heat sink **70** located in the bottom portion of the chamber being entirely positioned therein. The internal heat sink **70** (FIG. **6**) is a round disc, which is smaller in diameter than the inner diameter of the vacuum chamber. The heat sink is hollow with multiple interior heat sink fins **180** (FIG. **7**) with the fins spaced apart from each other forming an interior maze **181** through which the first heat transfer fluid from the first heat transfer fluid tube **39** (FIG. **1**) enters via heat sink inlet **182** (FIG. **7**) thereby allowing the heat from the solar radiation directed into the fins to he transferred to the first heat transfer fluid passing through the maze. A coupling **209** is provided on the bottom portion of chamber **160** which is connected to tube **39** directing the incoming fluid to heat sink **70**. A second coupling **221** is provided in the bottom portion of chamber **160** which is connected to tube **44** receiving the fluid from the heat sink **70**.

Chamber **160** is mounted to the dish **67** with one half of the chamber extending above the upper surface **195** (FIG. **6**) of the dish and the remaining one half of the chamber extending below the dish, A reflective coating **197** (FIG. **9**) on the interior surface of side wall **161** extends from the dish down through the lower half of the chamber and into a partial vacuum interior **208** at the bottom of the chamber. The coating **197** forms a corner coating **196** at each of the corners formed between the side walls and the bottom wall of interior **208** beneath the heat sink. Coating **197** prevents stray light from exiting the bottom of the chamber and will reflect the light back into the bottom and top of the heat sink. Such a coating is available from the 3M Company under the designation Solar Mirror Film 1100.

Chamber **160** extends below heat sink **70** forming a partial vacuum interior **208** in communication with a vacuum evacuator hose nozzle **210**. In the embodiment of FIG. **1**, three identical collector concentrators **61**-**63** with vacuum chambers and heat sinks are arranged in series so that the first heat transfer fluid heated by each heat sink successively adds heat to the first heat transfer fluid flowing through each sink. The heated first heat transfer fluid is then routed into boiler **80** to heat the second heat transfer fluid in the boiler.

Referring to FIG. **13**, in the embodiment, having the forward-facing shape concentrator (FIG. **11**), the vacuum chamber for receiving the concentrated solar radiation is elongated to match the changed focal point **1102** to maximize the collected solar energy. Solar rays directed from the forward facing concentrator are focused into the vacuum chamber without spillover losses. The inner reflective sheets **1301** reflect and direct incoming solar radiation **1312** to the main heat sink **1305** for transfer of solar radiation into heat for the heat transfer fluid (HTF) system. This novel design for the vacuum chamber heat sink allows matching of the new ringed focal point, increased efficiency and gain of the entire collection/concentration antennae apparatus.

Referring to FIG. **8** there is shown a flow diagram of the solar power system. Preheated second heat transfer fluid flows outwardly from panel **30** via tube **38** directly to boiler **80** where it empties into the boiler. Pre-heated first heat transfer fluid flows outwardly from panel **30** via tube **39** to the inlet **182** (FIG. **7**) of heat sink **70** of the first collector concentrator **61** where the first heat transfer fluid flows through the maze **181** of the heat sink while receiving heat from the heat sink and exiting via outlet **183**. Conduit **44** is connected to outlet **183** routing the heated first heat transfer fluid to the inlet of the heat sink **71** of the second collector concentrator **62** where the first heat transfer fluid flows through the maze of the second heat sink. **71** wherein additional heat is added to the first heat transfer fluid. The first heat transfer fluid exits the outlet of heat sink **71** which is connected to conduit **45**. Conduit **45** is connected to the outlet of heat sink **71** and the inlet of heat sink **72** of the third collector concentrator **63**. The first heat transfer fluid is routed through the maze of heat sink **72** where additional heat is added to the first heat transfer fluid. Conduit **46** is connected to the. outlet of heat sink **72** and the inlet of a coil **184** (FIG.) of boiler **80** wherein the heat in the first heat transfer fluid flows from the coil to the second heat transfer fluid contained in the boiler.

In the preferred embodiment, water is used as the second heat transfer fluid preheated in panel **30** and directed via tube **38** to boiler **80** although if is understood that other flowable fluids may be utilized. Steam is created within the boiler and routed from the boiler **80** via conduit **190** to the inlet of a bladeless turbine **100** wherein the steam drives the discs of the turbine.

In one embodiment, a water-tube fire-tube triple chamber rapid flash steam boiler yields higher temperatures and pressures for operating the turbine while reducing the time of the water-to-steam cycle. Referring to FIG. **12**, the boiler is separated into three main chambers, water-tube **1224**, fire-tube **1225** and fire-tube **1226** each chamber having incrementally increased water temperature and pressure from the prior chamber. The heated flowable fluid enters the boiler at inlets **1202** and **1203** and exits through outlets **1215**, **1216** and **1217** all three converging into the fluid vacuum pump **1218**, which then recirculates the fluid in a closed-loop system for reheating by the vacuum chamber heat sink array. Hot water enters the first chamber **1224** of the boiler **1201** and then begins to circulate into the water-tube chamber through a closed tube array **1205** down, around the base of the chamber and then up to the first fire-tube chamber **1225** through isolated section tubes **1206**.

In chamber two **1225** the water gains both in temperature and pressure and finally enters chamber three **1226** through smaller sealed inter-chamber tubes **1207** where additional temperature and pressure increases to produce the desired saturated steam pressure needed to operate the system turbine (FIG. **15**). The heated fluid is split between the three chambers **1224**, **1225** and **1226** in a way that the heated fluid is free flowing in **1224** and circulates around the water tubes **1205** thus acting as a water-tube boiler. The heated fluid in chamber **1225** enters into a corrugated accordion style heat exchanger **1211** and acts as a fire-tube boiler stage. The heated fluid in **1226** enters into a micro corrugated accordion style heat exchanger **1212** and acts as a final fire-tube boiler stage to impart the needed energy and heat to produce the desired output steam pressure and hourly volume needed to run the system turbine, in the final chamber **1226** there is a thin aluminum sheet with perforated holes **1227**, which inhibits rapid gas expansion and levels the vapor pressure of the pressurized water opposed to the steam vapor gas dome **1213**. Final pressurized steam exits through controlled port **1214** and is directed into the adjoining turbine. The triple chamber design allows for a greater amount of water to pass through the boiler achieving higher temperatures and pressures in a decreased water to steam cycle.

Downstream from the boiler, the fluid from conduit **190** acts on the turbine discs imparting rotary motion to an axle upon which the discs are mounted. An Epicyclic Gearbox or Planetary Gearbox **120** may be used to step down the high turbine RPM for driving an alternator **192** to produce alternating current. Such gearboxes and alternators are well known in the industry. Bladeless turbines are known. For example, U.S. Pat. No. 1,061,206 discloses art example of a bladeless turbine.

In one embodiment, the system turbine is a bladeless turbine. In another embodiment, Applicant's new modular barrier layer (MBLT) or bladeless turbine is utilized with the power system. Referring to FIGS. **15-16**, the MBLT may be expandable to meet higher pressure and temperature needs for future usage is shown. Heated fluid under pressure enters the MBLT at the inlet port **1604** and directly interacts with discs **1510** by means of adhesion and viscosity imparted to each disc's flat interior. The flowable fluid causes the internal discs to rotate around a central shaft **1502** which is fixed to each disc. The rotational torque energy imparted to the shaft in turn drives auxiliary generating apparatus, i.e., an alternator. The flowable fluid exits the MBLT through an external port **1507**. An example of a four stage modular turbine is illustrated in FIG. **16**. The design of the MBLT lends to ease of manufacturing, cost decreases, lower maintenance and the ability to work with many high pressure, high temperature, gas/fluid inputs and industrial exhaust gases.

The steam, in the case of water being used as the second heat transfer fluid in boiler **80**, passes through turbine **100** and is converted to water which is then routed back via conduit **191** to the water tube **38** connected to the inlet of the panel preheating device **30** to continue the process. The first heat transfer fluid routed through the coil **184** of boiler **80** is routed back via conduit **47** to the first heat transfer fluid inlet tube **39** connected to the inlet of the panel preheating device **30** to continue the process.

With reference to FIG. **14**, a heat capture noise reduction enclosure improves operating efficiencies of the turbine. The outer rigid shell **1401** is made of vacuum impregnated panel (VIP) material which creates a solid outer shell for the enclosure. Inner thermal insulating foam **1402** provides for heat capture and reduces substantially heat loss for the turbine dining operation. A double walled flexible metal mesh **1403** provides a barrier between the turbine (shown diagrammatically) and the Inner thermal insulating foam **1402** to prevent abrasive deterioration of the foam inner structure caused by vibrational forces during turbine operation. Other known high heat and abrasion resistant materials may be used to produce the enclosure.

Many variations are contemplated and included in the present invention. For example, once the solar power system is operating at full power, the wafer circulated through the system can be switched from a closed loop system to provide hot water for commercial and residential usage. Hot water storage tanks (hot water heaters), interior floor tube heating, hot tubs, and swimming pools can be fed from the excess hot water. As described above, the system and its components are scalable for domestic and industrial applications.

Another use of the present invention is to power a desalination system by connecting a hydroturbine to the condenser of a steam turbine for the purpose of producing desalinated water. U.S. Pat. No. 8,341,961 is herewith incorporated by reference for showing how one such steam turbine is used to produce desalinated water. The system disclosed herein is particularly useful when at a predetermined time, nearing the end of the sunlight day, the system will again be switched to a closed loop arrangement but in a stagnate state gaining heat and storing it for the next days needed start-up temperature.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

What is claimed is:

1. A solar power system for converting solar radiation from the sun into electrical energy comprising:

a pre-heater including a first tube to hold a first hear transfer fluid and a second tube to hold a second heat transfer fluid, said first tube and said second tube have side walls allowing solar radiation to flow inwardly through said side walls and preheat said first heat transfer fluid and second heat transfer fluid but limiting flow of radiation outwardly through said side walls;

a collector concentrator having aparabolic dish with an outer surface receded from a pure parabola shape for producing a ringed focal area,the dish includes a vacuum chamber which has an internal heat sink with a circuitous passage, said collector concentrator collecting solar radiation and concentrating energy via said vacuum chamber into said heat sink:

a first heat transfer fluid conduit extending to and between said first tube and said heat sink routing said first heat, transfer fluid through said circuitous passage of said heat sink to allow heat in said heat sink to be absorbed by said first heat transfer fluid in said first conduit;

a boiler having a steam output for steam to flow outwardly there from;

a second heat transfer fluid conduit extending to and between said second tube and said boiler routing said second heat transfer fluid in said second tube into said boiler;

a turbine operable to convert energy into a mechanical output;

a steam conduit extending to and between said output of said boiler and an input of said steam turbine routing steam from said output of said boiler into said turbine; and an alternator operable to convert said mechanical output into electrical energy.

2. The solar power system of claim **1** in which said pre-heater is pivotably mounted and movable to orient said first tube and said second tube to remain perpendicular relative to the solar radiation.

3. The solar power system of claim **1** in which said side walls of said first tube and said second tube have an internally located metal blocking wall limiting outwardly flow of energy through said side walls.

4. The solar power system, of claim **1** further comprising a plurality of combination collector concentrators each having a heat sink with circuitous passage through which said first heat transfer fluid, from said pre-heater is routed.

5. The solar power system of claim **1** in which said pre-heater includes an enclosure holding said first tube and said second tube, said enclosure having an internal atmosphere at lower pressure than ambient atmosphere surrounding said enclosure, said enclosure having a transmissive wall through which solar radiation may flow to said first tube and said second tube, said first and second tubes extend circuitously through said enclosure behind said transmissive wall, said pre-heater is pivotable to orient said transmissive wall to remain perpendicular to the solar radiation.

6. The solar power system of claim **1** in which said collector and concentrator includes a primary reflector dish to receive solar radiation, a secondary reflector to receive solar radiation reflected off of said primary reflector dish, said secondary reflector is hyperparabolic, said vacuum chamber receives said solar radiation from said secondary reflector and directs same into said heat sink, said vacuum chamber directing accumulated solar radiation from said secondary reflector toward said heat sink.

7. The solar power system of claim **6** in which said collector concentrator includes a cassegrain antenna.

8. The solar power system of claim **6** in which said boiler has at least one inlet connected to said second heat transfer fluid conduit to receive second heat transfer fluid from said second conduit, and has three heat chambers connected to said first heat transfer fluid conduit to receive first heat transfer fluid in said first heat transfer fluid conduit and the heat therein to heat second heat transfer fluid within said boiler to produce steam routed outwardly from said boiler via said steam output, said first heat transfer fluid is a gas and said second heat transfer fluid is a liquid;

said first tube and said second tube are in a side by side relationship in said pre-heater and are glass withstanding pressures of 100 atmospheres within each tube; and said turbine is a bladeless turbine.

9. A solar power system for converting solar radiation into electrical energy comprising:

a pre-heater to convert solar radiation into heat including housing having a first tube holding a first heat transfer fluid and a second tube holding a second heat transfer fluid, said first tube and said second tube winding though said housing, said housing has a radiation transmissive wall for allowing solar radiation to penetrate into said housing to said first tube and said second tube allowing solar radiation to penetrate respective side walls of said first and second tubes to preheat said first heat transfer fluid and said second heat transfer fluid;

a plurality of dishes with concave shapes to collect solar radiation, each of said dishes including a concentrator with a vacuum chamber and a heat sink mounted to and beneath a corresponding dish to receive solar radiation collected by said dish and concentrate the radiation into said heat sink, respectively;

a three-chamber boiler to heat said second heat transfer fluid, said three chambers comprising a water tube, a first fire tube and a second fire tube for said first heat transfer fluid to flow and operable to heat said second heat transfer fluid within said boiler;

first conduit connecting said first tube to said heat sinks and operable to allow heat to transfer from said heat sinks into said first heat transfer fluid and then routing said first heat transfer fluid to said three chambers in said boiler to transfer heat in said first heat transfer fluid to second heat transfer fluid within said boiler, and to produce steam for output through a port formed in the boiler; and,

a second conduit connecting said pre-heater to said boiler and operable to direct fluid to flow into said boiler.

10. The solar power system of claim **9** in which said first tube and said second tube each has an interior passage defined by walls with a top portion and a bottom, a heat blocking barrier positioned inside the passage adjacent the bottom to limit outward flow of heat.

11. The solar power system of claim **10** and further comprising said first conduit means connected to said pre-heater and said boiler to route first heat transfer fluid, which is gas, in said coil back to said pre-heater; and

said second conduit connected to said boiler and said pre-heater to route second heat transfer fluid, which is water, in said boiler back to said pre-heater.

12. The solar power system of claim **11** in which each of said vacuum chambers include solar radiation inlets and, said inlets positioned to receive solar radiation from said dishes, each of said chambers includes a reflective surfaces to direct solar radiation within said chambers into said heat sinks.

13. A solar power system for converting solar radiation into electrical energy comprising:

a first tube holding a first heat transfer fluid;

a second tube holding a second heat transfer fluid, said first tube and said second tube both having side walls allowing solar radiation to penetrate therein to respectively said first heat transfer fluid and said second heat transfer fluid;

a solar collector concentrator to convert solar radiation into heat energy, said collector concentrator having a collector dish, a vacuum chamber, a heat sink to receive solar radiation collected by the dish and a forward facing concentrator supported above the collector dish for directing the solar radiation from said collector dish downwardly to the vacuum chamber and the heat sink;

a boiler in which to heat said second heat transfer fluid and for said first heat transfer fluid to flow through boiler and heat second heat said second heat transfer fluid;

first conduit connecting said first tube to said heat sink and operable to allow heat to transfer from said heat sink into said first heat transfer fluid and then routing said first heat transfer fluid to said boiler to transfer heat in said first heat transfer fluid to second heat transfer fluid within said boiler; and,

second conduit connecting said second tube to said boiler and operable to direct second heat transfer fluid in said second conduit means to flow into said boiler.

14. The solar power system of claim **13** in which said heat sink includes a plurality of fins creating a maze through which first heat transfer fluid from said first conduit means is routed.

15. The solar power system of claim **14** and further comprising a turbine connected to said boiler to receive steam from the boiler created by said first heat transfer fluid; and,

an alternator connected to said turbine.

16. The solar power system of claim **15** in which the turbine is enclosed in a noise reduction enclosure, said enclosure having a rigid outer shell with an insulative foam interior to prevent heat loss during operation of the turbine.

17. The solar power system of claim **13** further comprising a housing having said first tube and said second tube winding there though, said housing having radiation transmissive wall means allowing solar radiation to penetrate into said housing means to said first tube and said second tube.

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